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ARS 34-7

A REPORT ON TETRA PETKUS,

A TETRAPLOID STRAIN OF RYE

Agricultural Research Service
U.S. DEPARTMENT OF AGRICULTURE

A REPORT ON TETRA PETKUS, A TETRAPLOID STRAIN OF RYE [1]

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There has been considerable interest in Tetra Petkus rye, a tetraploid variety developed in Germany. First grown about 8 years ago in the United States on an experimental scale, it has since become of importance commercially. Studies were undertaken to obtain a better understanding of the quality of the variety based on grain grown in Wisconsin and Pennsylvania. For comparative purposes the five diploid rye varieties Imperial, Caribou, Adams, Balbo, and Von Rumker, grown under comparable conditions with Tetra Petkus in 1954 and 1955 were included in the study.

AGRONOMIC CHARACTERISTICS

Tetra Petkus is of current interest because it is being grown in a dozen or more states. It does poorly in southern areas. It does not perform well where earliness is important, nor does it do well where great winter hardiness is required.

Tetra Petkus was developed by Dr. W. Laube in Germany by treating diploid Petkus with colchicine to double the number of chromosomes in the plant. It has shown good fertility when isolated from ordinary rye but requires an abundance of its own pollen to give a high seed set.

Careful studies have shown that ovule abortion occurs when the tetraploid is pollinated by ordinary (diploid) rye. This not only reduces the grain yield of the current crop but also makes the seed poorly suited for sowing. Forty rods or more isolation from diploid rye is recommended when growing this variety for seed.

1/ Acknowledgment is made to the personnel of the Grain Division, Agricultural Marketing Service, U. S. Department of Agriculture, for performing some of the quality tests; to Pillsbury Mills, Inc., Minneapolis, Minn., for use of the amylograph equipment; and to the Wisconsin and Pennsylvania Agricultural Experiment Stations for supplying the grain samples.

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Tetra Petkus produces a coarse, vigorous plant that stands up better on rich soils than most diploid varieties, but is matures later. It is susceptible to soil-borne mosaic, mildew, and leaf rust. The seed is about double the size of ordinary rye varieties; hence, the sowing rate should be proportionately greater than for ordinary rye.

QUALITY

Milling Performance

An unbleached patent or white rye flour was made and used for the chemical, physical, and baking tests. Results are shown in Table 1 along with data on the grain prior to milling. The samples of Tetra Petkus rye milled satisfactorily and produced flour similar to the standard varieties in color, feel, and granulation. The bran of the Tetra Petkus was easy to clean free from flour, and the flour sieved or bolted in a normal manner.

The weight of 1,000 kernels of Tetra Petkus averaged materially higher than the weight of the same number of kernels of diploid rye varieties. This was expected, as Tetra Petkus seeds are about twice the size of ordinary rye. Mixtures of the two sizes would obviously increase the difficulties of cleaning operations preparatory to milling.

Average values for comparably grown varieties tested in the 2 years show that Tetra Petkus rye was 1.4 pounds lower in test weight per bushel but produced about the same percentage of flour as the diploid rye samples. Information gathered by Carl Ross, Agricultural and Industrial Development Corporation, Harrisburg, Pa., showed that this variety produced a higher yield of flour than did standard ryes.

Chemical Analysis

In the Wisconsin composite samples the protein content of Tetra Petkus was 1.1 percent higher than the Adams variety grown under similar conditions. In the Pennsylvania composite, however, the Tetra Petkus rye had about the same protein content as Von Rumker, but was below the protein content of Balbo by 1.8 percent. The 1954 crop showed that the Tetra Petkus rye was higher in protein content than the control samples.

Average values for comparably grown varieties tested in the 2 years showed that Tetra Petkus was about 0.8 percent higher in protein content than the diploid varieties. Studies by European investigators have also found a higher protein content for this variety as compared with diploid rye varieties grown under comparable conditions.

Considering the data as a whole, the ash of Tetra Petkus flour averaged about the same as the flour milled from the control samples.

Tests for diastatic activity were made as a measure of the enzyme diastase present, or gas-producing capacity of the flour. The data show that the diastatic enzymes of the Tetra Petkus flours were higher than in the diploid rye varieties in two comparisons of comparably grown samples and slightly lower in the third test.

Physical Tests

The baking quality of rye flour can be markedly influenced by its alpha-amylase activity. If this activity is too high, excessive liquefaction and dextrinization of the starch occur, with a resultant lowering of the ability of the flour to bind the water liberated by the denaturation of the proteins during baking. The bread from such flours generally has a moist crumb with gummy characteristics. On the other hand, insufficient alpha-amylase is characterized by a dry, brittle crumb. Since these crumb properties are associated with the liquefying and dextrinizing action of alpha-amylase, a determination of the viscosity of gelatinized suspensions provides a convenient means of evaluating rye products for baking.

Amylograph tests were made of the rye flours as a measure of their alpha-amylase activity. The most significant finding was that Tetra Petkus was higher in amylase activity (indicated by a lower curve and amylograph value) than were the comparably grown diploid varieties Adams, Balbo, and Von Rumker.

An analysis of the individual flours indicates that the composite 1955 Wisconsin-grown Tetra Petkus samples were fairly high in amylase activity. The bread made with a blend of 40 percent rye and 60 percent 1st clear wheat flour showed signs of producing a loaf having a slightly gummy crumb characteristic. The amylograph curve for the Pennsylvania-grown Tetra Petkus was very unusual and indicated possibly a different chemical or physical make-up, perhaps related, in part, to the protein composition. It was of interest that the Tetra Petkus grown in Pennsylvania had a medium high amylograph value, possibly indicative of a lower amylase activity than the Wisconsin-grown samples. Pure rye flours having amylograph values about the same as or higher than the Pennsylvania-grown Tetra Petkus generally produce satisfactory doughs. These doughs do not generally have the objectionable sticky properties associated with rye flours of lower amylograph values. The diploid varieties Balbo and Von Rumker grown in Pennsylvania were in the desirable range and were found to be low in alpha-amylase activity.

Mixogram curves have been made of the 100-percent rye flours as an index of the quality of the different varieties. The data in Table 1 show some differences in quality between Tetra Petkus and the diploid ryes. Tetra Petkus flours appear to be slightly better in mixing tolerance and somewhat stronger in general physical dough properties than the diploid varieties Adams, Balbo, and Von Rumker.

Bread-Baking Tests

The Tetra Petkus rye flour, considering the data as a whole, made bread that was generally satisfactory and of about the same quality as the bread from the diploid rye samples grown under similar conditions. Bread from the Tetra Petkus 1954-crop samples, however, scored somewhat lower in grain and texture than bread from the diploid ryes. In both years the doughs from the Tetra Petkus samples were very sticky and handled with some difficulty. They were inferior to the doughs of the diploid rye flours in this respect. Water absorption was not much different among the samples except possibly those from the Pennsylvania composite, in which the Tetra Petkus was lowest.

Tasting Tests

One of the important properties of rye flour used for bread-making purposes is the flavor that it imparts to the bread. Bread made from Tetra Petkus flour was compared in flavor with flour from Imperial, Adams, and Caribou (1954) and with Adams (1955). Bread made from 50 percent rye (a higher amount of rye than employed in the tests reported in table 1, in order to amplify differences) and 50 percent 1st clear wheat flour was used for the tasting studies.

In the 1954 studies, 12 among 15 tasters indicated that the flavor was stronger in the Tetra Petkus bread than in that of the 3 diploid ryes included for comparison. The results in 1955 showed that 9 members on a 20-member team found the bread made from Tetra Petkus had a stronger and more pleasing rye flavor than that of the bread from the variety Adams. Six members found no differences in flavor between the breads made from Tetra Petkus and Adams, and 5 indicated that the flavor of the bread from the Adams variety was better.

The stronger rye flavor in Tetra Petkus appears to be a consistent and valuable characteristic.

Table 1.--Chemical, milling, and baking results on Tetra Petkus and other varieties of rye grown in Wisconsin and Pennsylvania in the years 1954 and 1955.

Kind of test and unit	Source of grain and variety								
	Madison, Wisconsin, 1954				Composite from Madison, Racine, Ashland and Marshfield, Wisc. 1955		Composite from Pennsylvania State University and Landisville, Pa. 1955		
	Imperial	Adams	Caribou	Tetra Petkus	Tetra Petkus	Adams	Tetra Petkus	Balbo	Von Rumker
Protein: 1/									
Grain ..... percent..	12.3	11.2	11.4	14.4	10.9	9.8	11.0	12.8	10.8
Flour ..... percent..	10.3	8.8	9.3	11.3	7.7	6.6	8.0	9.6	7.4
Weight per 1000 kernels ..... grams..	--	--	--	--	41.75	26.12	43.70	27.15	31.72
Flour ash 1/ ..... percent..	.66	.67	.44	.48	.58	.58	.63	.64	.65
Diastatic activity 2/ ..... milligrams..	209	224	220	261	200.8	216.6	180.2	165.2	162.0
Test Wt. per bushel 3/ ..... pounds..	55.8	56.0	56.9	52.1	52.5	52.1	54.5	56.2	55.5
Flour yield - 4/ ..... percent..	61.4	62.8	61.9	61.9	57.9	60.1	62.2	57.0	60.8
Amylograph (flour) values	--	--	--	--	167	292	340	850	565
Mixogram pattern	--	--	--	--	Med.weak	Weak	Weak	V.weak	Weak
Bread: 5/									
Blend of 40% rye: 60% 1st clear wheat flour:									
Absorption ..... percent..	59.0	59.0	60.0	61.0	60.0	58.5	59.0	62.0	63.0
Dough-mixing time ..... minutes..	1.25	1.25	1.25	1.25	1.37	1.37	1.25	1.25	1.25
Loaf volume ..... cubic centimeters..	676	662	687	678	659	645	651	656	694
Grain and texture ..... score..	70 G	70 G	65 G	50 G	90	85	70 G	90 VG	95 VG
Crumb color ..... score..	45 Cr gr	45 Cr gr	45 Cr gr	45 Cr gr	45	45	40 Br	50 Br	50 Br

1/ 14.0 percent moisture basis.
2/ Milligrams of maltose per 10 grams of flour.
3/ Dockage free.
4/ Moisture free basis.
5/ Formula ingredients -- flour, salt, yeast, shortening, and water.

Symbols Used: VG, very good; G, good; Br, brown; Cr gr, creamy gray.